CFSE Value = $\frac{\text{No. of orbitals in opposite side} \times 10\,Dq}{\text{Total no. of orbitals}}$

example for e_g CFSE = $\frac{3 \times 10\,Dq}{5}$ = 6 Dq.

example for t_{2g} CFSE = $\frac{-2 \times 10\,Dq}{5}$ = -4 Dq.

Splitting of d-orbital in tetrahedral field :-

When ligand approch towards d-orbital then split into two set of orbitals one in e and other in t_2.

⇒ Here, doesn't use g because tetrahedral is less symmetrical than octahedral

⇒ e- set of orbital having less energy and migrate downward from berry centre (zero energy level) and t_2 set of orbital having migrate upward from berry centre because having more energy.

CFSE – (Crystal field Stabilization energy)

The amount of energy which Stabilised complex compound.

When CFSE Value ↑ then ↑ Stability of complex compound ↓ reactivity of complex compound.

Factors effecting Value of CFSE –

i) Oxidation No. –

When oxidation no. of central atom (metal of d and f block) ↑ then ↑ CFSE Value.

eg → $K_2[Fe^{+4}(Cl)_6] > K_3[Fe^{+3}(Cl)_6] > K_4[Fe^{+2}(Cl)_6]$

ii) Size of metal –

When size of metal (d & f-block) ↑ then ↑ CFSE Value.

eg → $K_4[Pt^{78}(Cl)_6] > K_4[Pd^{46}(Cl)_6] > K_4[Ni^{28}(Cl)_6]$

iii) Chelating effect –

When ring form tendency ↑ then ↑ Stability of complex compound.

eg → $K_4[Fe(EDTA)]$ (Hexa D.D.L) > $K_4[Fe(en)_3]$ (B.D.L) > $K_4[Fe(Cl)_6]$ (M.D.L)

Chelling ligand - Ligand having density equal or greater than 3.

eg -> EDTA, en, C_2O_4 (oxalate)

⇒ Calculation of CFSE in Octahedral field -

CFSE in octahedral = $+0.4\ eg_n \pm 0.6\ t_{2g_n} + mp$.

CFSE in tetrahedral = $+0.6\ t_{2n} \pm 0.4\ e_n + mp$.

where,

eg_n = No. of e^- in eg set of orbital

t_{2g_n} = No. of e^- in t_{2g} set of orbital.

t_{2n} = No. of e^- in t - set of orbital.

e_n = No. of e^- in e - set of orbital.

m = No. of e^- in paired Orbital.

p = Pairing energy.

Q. Find CFSE of $K_4[Co(CN)_6]$ having pairing energy 7 KCl.

$K_4[Co(CN)_6]$ =

$4 + x - 6 = 0$

$x = 2$

$Co = [Ar], 3d^7, 4s^2$

27

$Co^{2+} = [Ar], 3d^7$.

↿⇂	↿⇂	↿	↿	

1 — eg

↿ ↿ ↿ t_{2g}

Teacher's Signature